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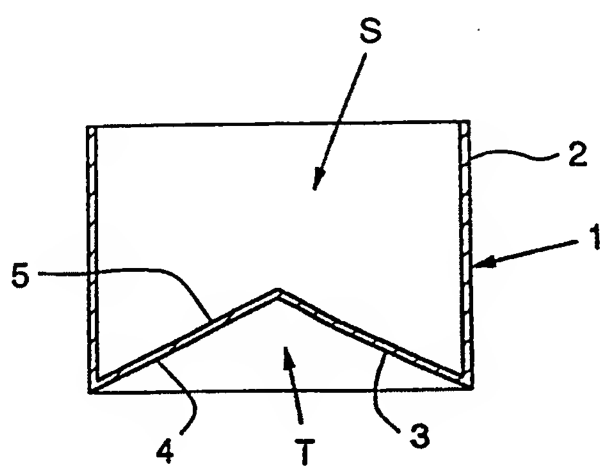

(57) Abstract

This invention relates to a method of manufacturing a contact lens which has a first section formed from a first material and a second section formed from a second material. The method includes the use of a casting mould (1) which has an end wall (3) that is inwardly displaced into the space defined within the mould to define a receptive well (S, T) into which material can be cast to be cured/polymerised to form a lens button (B). The method further includes: casting a first monomer material into the receptive well of the casting mould and polymerising/curing the monomer material; and machining the article formed by the above casting into a contact lens (CL) wherein the first monomer material includes a polymerisable material which has a penetrating-like action with respect to the material from which the casting mould is formed that acts to bond the mould and the cured/polymerised material together.

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A METHOD OF MANUFACTURING A CONTACT LENS

Background of the Invention

Field of the Invention

This invention relates to a method of manufacturing a contact lens, and, in particular, to a method of manufacturing a contact lens from two or more differing materials, for example a composite lens, bifocal or trifocal lens.

State of the Art

Normally these contact lenses when formed from two or more materials are formed with a first member formed from a first material and a second member formed from a second material. In one particular example of this, a composite lens which is generically known as "Saturn" in the industry, the first member comprises the optical zone of the lenses and is normally made from a "hard" material such as a rigid gas permeable (RGP) material, and the second member comprises a skirt around the optical zone and is normally made from a "soft" material, such as a hydrogel material. At present composite lenses of the general type described above are manufactured from buttons that are formed by the following process steps:

(a) forming a first rod of material by polymerisation of a first monomer material;

(b) forming a layer of a second material about said first rod of material by polymerisation; and

(c) transversely slicing the rod so formed into buttons.

The problems associated with the above-mentioned manufacturing technique for the button include:

(a) The first rod of material must be located centrally within the finished buttons. With the procedures employed in the industry this is not so easily achieved, and consequently there is considerable scope for error from this aspect, leading to a high rejection level of rods and buttons.

(b) The actual diameter of the first rod of material provides the dimensions of a significant characteristic of the finished lens. Therefore the first rod of material has to have a uniform diameter.

(c) The adhesion between the two materials of the two members as a result of the different character of the materials of the composite lens may be very low, and when this is combined with the fact that the soft contact lens material will be swollen after manufacture and prior to use, thus exerting a considerable force on this adhesion, the problems can be significant.

The net result of the above is that the production of composite contact lenses using buttons in accordance with the above-detailed method is expensive and results in a high rejection rate of rods, buttons and lenses.

The situations and problems above have been discussed with regard to one particular example, namely a "Saturn" lens. It should, however, be noted that the situation and problems are very similar to those that would be encountered for the production of bifocal and other multifocal lenses from two or more different polymeric materials.

Summary of the Invention

The present invention is concerned with providing a method of manufacturing contact lenses, for example composite contact lenses or

multifocal contact lenses, in which the above-discussed problems have at least been alleviated or reduced significantly.

In accordance with the present invention in its broadest scope, there is disclosed a method of manufacturing a contact lens which has a first section formed from a first material and a second section formed from a second material, which contact lens is manufactured by using a casting mould of generally cylindrical construction and having a side wall and an end wall, which end wall has an inward displacement into the space defined by the side wall, which space defined by the side wall and end wall is a receptive well into which material can be cast to be cured/polymerised, which method comprises:

casting a first monomer material into the receptive well of the casting mould, and polymerising/curing the monomer material; and

machining the article formed by the above casting into a contact lens;

wherein the first monomer material includes a polymerisable material which has a penetrating-like action with respect to the material from which the end wall of the casting mould is formed.

The casting moulds for use in the method of manufacture of the present invention can be mass produced from suitable contact lens materials relatively cheaply and with a high degree of accuracy. For example, the moulds may be produced by moulding the material in a polystyrene mould, the polystyrene mould itself being injection moulded at a very low cost.

From this it will be readily understood by those in the industry that contact lenses which are made from two or more different materials can

be made by the method in accordance with the present invention cheaply and easily, as the problems of the currently known process are significantly alleviated if not eliminated altogether.

In one arrangement of the present invention, the inward displacement of the end wall of the casting mould is a solid projection, the material of which forms one of the sections of the contact lens.

Alternatively, the inward displacement of the end wall of the casting mould may define a second receptive well into which a second monomer material may be cast and subsequently polymerised/cured prior to machining.

In accordance with a second aspect of the present invention, a method of manufacturing a contact lens which has a first section formed from a first material and a second section formed from a second material, which contact lens is manufactured by using a casting mould of cylindrical construction and having a side wall and an end wall, which end wall has an inward displacement into a space defined by the side wall so that the casting mould has two receptive wells for the casting of material to be cured/polymerised which are separated from one another by the end wall of the casting mould, which method comprises:

casting a first monomer material into one of the receptive wells of the casting mould and polymerising/curing the monomer material;

casting a second monomer material into the other receptive well of the casting mould and polymerising/curing the monomer material; and

machining the article formed by the above castings into a contact lens;

wherein the first and second monomer materials include a polymerisable material which has a penetrating-like action with respect to the material from which the end wall of the casting mould is formed.

The inclusion in the first and second monomer materials of a polymerisable material with a penetrating-like action with respect to the material of the end wall of the casting mould means that the polymerisable material softens, swells and/or dissolves the surface material of the end wall of the casting mould, and upon polymerisation a very strong bonded interface is produced between the monomer material cast and the end wall of the casting mould. In fact, the bond strength of a button made in accordance with the present invention is significantly increased over that which would be present should the two materials have been placed in direct bonding contact.

When both of the casting operations have been completed a button is formed which includes the end wall of the casting mould sandwiched between the two bodies of polymerised first and second monomer material, each of the bodies of polymerised first and second monomer material being strongly bonded to the respective surface of the end wall of the casting mould, as discussed in the paragraph above.

The incorporation of the casting mould, or a part thereof, into the button means that the method in accordance with the present invention utilises a simple one- or two-stage cast moulding operation which is significantly cheaper to operate than the presently used method.

The accuracy of the alignment of the two materials, centre and skirt, is easily achieved by accurate manufacture of the casting mould, for

example by injection moulding. Consequently, centration is ensured by the mould. In a preferred embodiment of the present invention the casting mould is formed with a side wall and end wall that are formed from the same material so that a strong interface is also formed between the cast material and the side wall.

Preferably, the end wall has an inward displacement into the space defined by the side wall of the casting mould which inward displacement is conical in shape.

The cone so formed as the inward displacement may have a base area which is any proportion of the area of the end wall of the mould up to 100%. Further, the cone may be located with its apex at the centre, or in line with the centre of the end wall, or off-centre therefrom.

Alternatively, the inward displacement in the end wall of the mould may comprise an upstanding cylinder. The upstanding cylinder may be of any suitable cross-sectional shape, for example, circular, oval, semi-circular or polygonal.

From the above it will be clearly apparent to anyone skilled in the industry that the method in accordance with the present invention can be used to manufacture contact lenses which have a member (or members).

The use of a casting mould having an inward displacement means that the two receptive wells of the casting mould are defined as follows:

1) one receptive well which is defined by the inward displacement in the end wall of the casting mould only; and

2) one receptive well which is defined by the side wall and the end wall.

In one particular arrangement of the present invention the end wall of the casting mould is formed from polymethyl methacrylate, and the polymerisable material with a penetrating-like action of the first and second monomer materials is methyl methacrylate.

As will be well appreciated by those skilled in the art, there is a close relationship between the choice of the mould material and the polymerisable material with a penetrating-like action, and the example given above is only that and is not to be construed as limiting on the invention as disclosed.

As a general point, liquid vinyl polymers and their monomers are useable in the present invention, for example, styrene, N-vinyl pyrrolidone (NVP), hydroxyethyl methacrylate (HEMA), dimethyl acrylamide (DMA), ethylene glycol dimethacrylate (EGDMA), and glycerol methacrylate (GMA).

In a first specific alternative of this arrangement of the present invention, the end wall of the casting mould is formed from cellulose acetate butyrate (for example, Eastman Kodak TENITE M6 350A [Rochester, New York, U.S.A.]), resin and plasticiser, with the polymerisable material with the penetrating-like action of the first and second monomer materials being a liquid vinyl monomer such as methyl methacrylate.

In a second alternative to the first arrangement of the present invention, the end wall of the casting mould is formed from polystyrene, with the polymerisable material with penetrating-like action of the first and second monomer materials being a liquid vinyl monomer such as N-vinyl pyrrolidone.

In one particular arrangement of the present invention, the end walls of the casting moulds are coloured. The colouring of the casting mould end wall means that when the finished lens has been cut/turned from the moulded bottom, the material of the first member and the second will be divided by a coloured ring-like zone.

In one particular use of this aspect of the present invention, the colouring of the casting mould can be used to provide a lens locating tint in the finished contact lens, which lens locating tint can be introduced into the finished lens without any inconvenience to the lens wearer, and at little additional cost, whilst providing the advantages associated with locater tints.

Alternatively, the colouring of the casting mould in the fashion disclosed can be used to provide a ring of distinct colour where required.

Additionally it should be noted that because the casting mould has distinct cast moulding areas, i.e., one or more receptive wells, each of the distinct zones of the finished contact lens can be separately coloured or not, to provide an adaptable method of manufacturing contact lenses.

The casting moulds for use with the method of the present invention are obviously formed with sufficient thickness of material to

provide the strength necessary to ensure that no deformation is experienced during the casting of the monomer materials and subsequent curing/polymerisation thereof. However, the end wall of the casting mould should not be of such thickness that it begins to interfere with the optical properties of the finished contact lens.

Preferably, the end wall of the casting mould has a thickness in the region of 0.1 mm to 2 mm.

In a majority of cases wherein the method of manufacturing a contact lens in accordance with the present invention is used, the casting mould for use therewith has an end wall which is of a fairly uniform thickness with respect to the side wall of the casting mould.

However in some circumstances it is envisaged that the thickness of the end wall will vary across said end wall. Now in the situation that the end wall has a conical inward displacement, the variation in thickness of the end wall may occur up the sides of the cone to its apex. Further, in the situation where the inward displacement is an upstanding cylinder which forms a second receptive well for containing a suitable material and polymerisation thereof, the variation in thickness of the end wall may occur around the side(s) of the upstanding cylinder.

Clearly, with regard to the thickness of the end wall of the casting mould the above comments more readily apply to casting moulds which have two receptive wells for the casting of material. Now in the situation wherein the casting mould has a solidly formed inward displacement, the limitations mentioned above will not apply at least to the area of the inward displacement.

The present invention may be used to manufacture contact lenses from any combination of materials or types of materials, for example hard and hard, hard and soft, and soft and soft.

The term "hard contact lens material" is well known in the industry, and within the general term there is included a large variety of materials. Most preferably, the hard contact lens material is a rigid gas permeable material, such as fluorocon.

The term "soft contact lens material" is well known in the industry and is the general term used in respect of hydrogel materials, that is materials which can be readily hydrolised/swollen under the action of water. Typically these materials are very soft and flexible in nature once hydrolysed.

Alternatively the "soft contact lens material" may be a silicone.

Preferably, the soft contact lens material is a hydrogel, such as that disclosed in co-pending U.S. Patent Application Serial No. 07/641,273.

Brief Description of the Drawings

Figure 1 shows a side view cross-section of a casting mould for use in a method of manufacturing a contact lens in accordance with the present invention.

Figures 2 to 4 show schematic representations of a method in accordance with the present invention.

Figure 5 shows a schematic side view cross-section of a contact lens made in accordance with the present invention.

Figure 6 shows a schematic plan view of the contact lens shown in Figure 5 of the accompanying drawings.

Figure 7 shows a cast button and finished lens for use in a second example of the present invention.

Figure 8 shows a cast button and finished lens for use in a third example of the present invention.

Figure 9 shows a cast button and finished lens for use in a fourth example of the present invention.

Figure 10 shows a cast button and finished lens for use in a fifth example of the present invention.

Figure 11 shows a cast button and finished lens for use in a sixth example of the present invention.

Figure 12 shows a cast button and finished lens for use in a seventh example of the present invention.

Detailed Description of the Preferred Embodiments

The invention will now be illustrated, by way of description of an example, with reference to the accompanying drawings.

Now referring to Figure 1 of the accompanying drawings, there is shown a casting mould 1 for use in a method of manufacturing a contact lens in accordance with the present invention.

The casting mould 1 is of cylindrical construction having a side wall 2 and an end wall 3. The end wall 3 is inwardly displaced into the space defined within the side wall 2 and is of conical construction.

With this configuration the casting mould 1 defines two receptive wells for holding liquid material. The first of these wells T is defined by

surface 4 of the end wall 3 and is external of the cylindrical side wall 2 of the casting mould 1. The second of the receptive wells S is defined by surface 5 of the end wall 3 and the cylindrical side wall 2 of the casting mould 1.

The end wall 3 of the casting mould has a thickness of 1.0 mm.

Now referring to Figures 2 to 6 of the accompanying drawings, a method of manufacturing a contact lens in accordance with the present invention will now be described.

The casting mould 1 is located so that the receptive well T thereof is capable of holding liquid monomeric material. The liquid monomeric material of a first material is poured into the receptive well T and polymerised.

When this polymerisation has been completed the receptive well T is filled with a hardened mass of polymeric material which is retained in place by the interaction of the cast monomeric material with the material of the end wall 3. The mould is now reversed and the receptive well S filled with liquid monomer of a second material which is then polymerised.

Once this second polymerisation operation is completed, a button as shown in Figure 3 is formed.

In order to complete the manufacture of the contact lens a first optical surface 6 is machined onto the button, as shown in Figure 4. The button is reversed, and the second optical surface 7 is machined thereon.

A contact lens so formed is shown in Figures 5 and 6 of the accompanying drawings. This contact lens comprises:

a skirt 8 formed from the material cast into the receptive well S of the casting mould 1; and

a central area 9 formed from the material cast into the receptive well T of the casting mould 1.

Once the contact lens has been machined from the button as described above, the material of the skirt 8 can then be hydrolysed and swollen to provide the material with its soft and pliable nature. This is done in accordance with the well known procedures currently used in the industry.

The actual diameter of the central area 9 formed in the contact lens, because of the conical nature of the receptive well T of the casting mould 1, is dependent upon the depth of cut used to form the contact lens from the button. Therefore, by adjusting the depth of cut used to form the contact lens from the button, the size of the central area 9 can be adjusted to the wearer's requirements and the lighting background in the area in which the wearer lives.

It will also be noticed that the interface between the skirt 8 and the central area 9 is quite marked in appearance. The effects of this interface can be adjusted by changing the angle of the conical end wall 3 and the thickness of the lens to provide the required characteristics.

Example 1

A contact lens as described above is formed by the above method as follows using a casting mould 1 which is formed with an end wall that is made from polymethyl methacrylate (PMMA).

The central area 9 (formed from the monomer material cast into receptive well T of the casting mould 1) is formed from a monomer mixture with the following composition:

3-Methacryloxy propyl tris(trimethyl-siloxy)silane	45%
1,3-bis(3 methacryloxy propyl)tetra bis (trimethyl siloxy) disiloxane	15%
Methyl methacrylate	25%
Methacrylic acid	9%
Ethylene glycol dimethacrylate	5.5%
2,2-azobis(2-methylpropanenitrile)	0.5%

The skirt 8 (formed from the monomer material cast into receptive well S of the casting mould 1) is formed from a monomer mixture with the following composition:

Hydroxyethyl methacrylate	69%
Polyethylene glycol	30%
Ethylene glycol dimethacrylate	0.5%
2,2-azobis(2-methylpropanenitrile)	0.5%

The contact lens is then cut with the central area 9 having a diameter of 9.00 mm and the skirt 8 having a diameter of 14.00 mm.

Now turning to Figure 7 of the accompanying drawings, a cast moulded button B and a cross-sectional view and plan view of a contact lens manufactured from the button B are shown.

The button B is cast moulded with a casting mould 20 which is incorporated into the finished button B. The casting mould 20 is manufactured from polymethyl methacrylate and is of generally circular configuration having a side wall 21 and a base wall 22. The base wall 22 of the casting mould is inwardly displaced in the shape of a regular cone into the space surrounded by the side wall 21 with the apex of the cone in line with the central axis of the side wall 21.

With the shaping of the casting mould, as described above, two receptive wells suitable for casting of polymeric material are defined; these are:

1) space S defined by the side wall 21 and base wall 22 and into which the material from which the second member is formed is cast; and

2) space T defined by the inward displacement in the base wall 22 and into which the material from which the first member is formed is cast.

In one particular example the material cast into the space S is a hydrogel material which is of the following composition:

Hydroxyethyl methacrylate	69%
Polyethylene glycol	30%
Ethylene glycol dimethacrylate	0.5%
2,2-azobis(2-methylpropanenitrile)	0.5%

The material cast into the space T is:

3-Methacryloxy propyl tris(trimethyl-siloxy)silane	45%
1,3-bis(3-methacryloxy propyl)tetra bis (trimethyl siloxy) disiloxane	15%
Methyl methacrylate	25%
Methacrylic acid	9%
Ethylene glycol dimethacrylate	5.5%
2,2-azobis(2-methylpropanenitrile)	0.5%

Now in Figure 7, the outline CL in the button shows the position of a contact lens which is to be machined from the button.

Further there is shown a cross-sectional view and a plan view of a contact lens so machined from the button. The lens has an outer member 23 and an inner member 24; these members are separated from one another by the casting mould 20.

Now turning to Figure 8 of the accompanying drawings, there is shown another cast moulded button B and a cross-sectional view and a plan view of a contact lens manufactured from the button B.

The description of this button B and the contact lens CL formed therefrom is very similar to that discussed with reference to Figure 7, and, consequently, like numerals have been used to indicate like components.

Now in this particular case the differences are in the shape and position of the inward displacement in the base wall 22.

In this case the inward displacement in the base wall is again conical in shape, however is slightly offset from the axis which runs through the casting mould 20. The net result of this can be clearly seen from the plan view of the contact lens in that the first member is elliptical in shape, and not circular as in the example discussed with respect to Figure 7 of the accompanying drawings.

The button B and the contact lens CL formed therefrom are formed from the same materials as discussed with regard to Figure 7 of the accompanying drawings.

Now turning to Figure 9 of the accompanying drawings, there is shown another form of cast button B, with cross-sectional view and plan view of a contact lens manufactured therefrom.

The description of this button and the contact lens formed therefrom is very similar to that discussed with reference to Figure 7 of the drawings, and, consequently, like numerals have been used to indicate like components.

In this particular case the differences are in the shape and position of the inward displacement of the base wall 22.

The inward displacement in the base wall 22 is cylindrical in shape, the central axis of the displacement being offset from the central axis of the casting mould.

Consequently, when the contact lens is machined from the cast button B, as with the contact lens discussed with regard to Figure 8 of the

accompanying drawings, the first member is elliptical in shape, and not circular.

The button B and the contact lens CL formed therefrom are formed from the same materials as discussed with regard to Figure 7 of the accompanying drawings.

Now turning to Figure 10 of the accompanying drawings, another form of cast button B and contact lens manufactured therefrom are shown.

The description of this button and the contact lens formed therefrom is very similar to that discussed with reference to Figure 7 of the accompanying drawings, and, consequently, like numerals have been used to describe like components.

In this case the differences are in the contraction of the casting mould 20 in the vicinity of the base. Previously, the casting mould 20 has been made so that the side wall 21 and the base wall 22 are of equivalent thickness. In the example now being illustrated, the base wall 22 is of much greater thickness than the side wall 21. The net effect of this is clearly shown in the plan view of the contact lens machined from the button B wherein the barrier between the first and second members of the contact lens provided by the casting mould 20 is much thicker than with the previous examples. Further, by having a higher refractive index of the casting mould material, a concentric bifocal lens is prepared.

The button B and the contact lens CL formed therefrom are formed with the same materials as discussed with regard to Figure 7 of the accompanying drawings.

Now turning to Figure 11 of the accompanying drawings, there is shown another form of cast button B and cross-sectional view and plan view of a contact lens manufactured therefrom.

In this case a casting mould 30 is manufactured from polystyrene and comprises a cylindrical side wall 31 with a base wall 32. The base wall 32 has an upstanding solid post member 33 which has an axis slightly offset kept parallel to the equivalent axis of the casting mould as a whole.

Now the casting mould 30 in this case may be manufactured by injection moulding into this particular fashion, or, alternatively, a casting mould similar to that shown in Figure 9 of the accompanying drawings may be used with the space T having polymer identical to that from which the casting mould 30 is made, cast and polymerised therein.

In any event, the casting mould defines only one receptive well for the casting of material to form the button. In this case polymeric material of the following composition is cast into the receptive well.

Hydroxyethyl methacrylate	69%
Polyethylene glycol	30%
Ethylene glycol dimethacrylate	0.5%
2,2-azobis(2-methylpropanenitrile)	0.5%

Once polymerised, the cast button B may be machined to form a contact lens which has a first member 34 formed from the material of the upstanding post of the casting mould and a second member 35 formed from the material cast into the receptive well of the mould.

Finally turning to Figure 12 of the accompanying drawings, a seventh basic design of cast button B and contact lens CL formed therefrom is shown.

In this particular example, the cast button B is formed using a casting mould 41 which is incorporated into the cast button B.

The casting mould 41 in this case is manufactured from an optically clear material, such as polystyrene. The mould 41 includes:

an end wall 42;

a first side wall 44 which circumferentially surrounds the periphery of the end wall 42 and is connected thereto; and

a second side wall 43 which is connected to the end wall 42 within the space defined by the first side wall 44.

A casting mould 41 of this fashion defines two receptive wells 45 and 46 into which polymeric monomer material can be cast in order to enable the forming of a cast button B, the receptive well 46 being circumferentially surrounded by the other receptive well 45.

The receptive well 45 is defined by the inner surfaces of the first side wall 44, the end wall 42 and the outer surface of the second side wall 43.

The receptive well 46 is defined by the inner surfaces of the second side wall 43 and the end wall 42.

In the formation of a cast button B, liquid monomeric material is cast into the receptive wells 45 and 46 and polymerised.

The method of casting a button using this casting mould 41 may be identical with that disclosed above for the formation of the casting button. However, with the casting button of the above type the receptive wells 45 and 46 are disposed on the same side so the liquid monomer material may be cast into the appropriate receptive well and polymerised/cured simultaneously. That is to say the first polymerising/curing step of the earlier detailed method has been left out.

In one particular example the liquid monomeric material cast into receptive well 45 comprises:

Hydroxyethyl methacrylate	69%
Polyethylene glycol	30%
Ethylene glycol dimethacrylate	0.5%
2,2-azobis(2-methylpropanenitrile)	0.5%

The liquid monomeric material cast into receptive well 46 comprises:

3-Methacryloxy propyl tris(trimethyl-siloxyl)silane	45%
1,3-bis(3-methacryloxy propyl)tetra bis(trimethylsiloxy) disiloxane	15%
Methyl methacrylate	25%
Methacrylic Acid	9%
Ethylene glycol dimethacrylate	5.5%
2,2-azobis(2-methylpropanenitrile)	0.5%

<u>What we claim is</u>

1. A method of manufacturing a contact lens which has a first section formed from a first material and a second section formed from a second material, which contact lens is manufactured by using a casting mould of generally cylindrical construction and having a side wall and an end wall, which end wall has an inward displacement into the space defined by the side wall, which space, defined by the side wall and end wall, is a receptive well into which material can be cast to be cured/polymerised, which method comprises:

casting a first monomer material into the receptive well of the casting mould and polymerising/curing the monomer material; and

machining the article formed by the above casting into a contact lens wherein the first monomer material includes a polymerisable material which has a penetrating-like action with respect to the material from which the end wall of the casting mould is formed.

2. A method of manufacturing a contact lens as claimed in Claim 1, wherein the inward displacement of the end wall of the casting mould is a solid projection, the material of which forms one of the sections of the contact lens.

3. A method of manufacturing a contact lens as claimed in Claim 1, wherein the inward displacement of the end wall of the casting mould may define a second receptive well into which a second monomer material may be cast and subsequently polymerised/cured prior to machining.

4. A method of manufacturing a composite contact lens which has a first section formed from a first material and a second section formed from a second material, which contact lens is manufactured by using a casting mould of cylindrical construction and having a side wall and an end wall, which end wall has an inward displacement into a space defined by the side wall so that the casting mould has two receptive wells for the casting of material to be cured/polymerised which are separated from one another by the end wall of the casting mould, which method comprises:

casting a first monomer material into one of the receptive wells of the casting mould;

casting a second monomer material into the other receptive well of the casting mould;

polymerising/curing the first and second monomer materials in the receptive wells; and

machining the article formed by the above castings into a contact lens wherein the first and second monomer materials include a polymerisable material which has a penetrating-like action with respect to the material from which the end wall of the casting mould is formed.

5. A method as claimed in Claim 4, wherein the first monomer material is polymerised/cured prior to the casting of the second monomer material.

6. A method as claimed in Claim 4, wherein the first and second monomer materials are polymerised/cured simultaneously.

7. A method of manufacturing a composite contact lens as claimed in Claim 1, wherein the casting mould is formed with a side wall

and end wall that are formed from the same material so a strong interface is also formed between the cast material and the side wall.

8. A method of manufacturing a contact lens as claimed in Claim 7, wherein the casting mould is formed from a thermoplastic material.

9. A method of manufacturing a composite contact lens as claimed in Claim 1, wherein the end wall has an inward displacement into the space defined by the side wall of the casting mould which inward displacement is conical in shape.

10. A method of manufacturing a composite contact lens as claimed in Claim 1, wherein the inward displacement in the end wall of the mould may comprise an upstanding cylinder.

11. A method of manufacturing a composite contact lens as claimed in Claim 1, wherein the end wall of the casting mould is formed from polymethyl methacrylate, and the penetrating-like material of the first and second monomer materials is methyl methacrylate.

12. A method of manufacturing a composite contact lens as claimed in Claim 1, wherein the end wall of the casting mould is formed from polymethyl methacrylate, and the penetrative-like material of the first and second monomer material is a methacrylate material.

13. A method of manufacturing a composite contact lens as claimed in Claim 1, wherein the end wall of the casting mould is formed

from cellulose acetate butyrate, and the penetrating-like material of the first and second monomer materials is a liquid vinyl monomer material.

14. A method of manufacturing a composite contact lens as claimed in Claim 1, wherein the end wall of the casting mould is formed from polystyrene, and the penetrating-like material of the first and second monomer material is a liquid vinyl monomer material.

15. A method of manufacturing a composite contact lens as claimed in Claim 1, wherein the end wall of the casting mould is coloured.

16. A method of manufacturing a composite contact lens as claimed in Claim 1, wherein the end wall of the casting mould has a thickness in the region of 0.1 mm to 2 mm.

17. A method of manufacturing a composite contact lens as claimed in Claim 1, wherein the end wall of the casting mould is any thermoplastic compatible with the vinylic monomer of the lens material.

18. A method of manufacturing a composite contact lens as claimed in Claim 4, wherein the casting mould is formed with a side wall and end wall that are formed from the same material, so a strong interface is also formed between the cast material and the side wall.

19. A method of manufacturing a composite contact lens as claimed in Claim 4, wherein the end wall has an inward displacement into the space defined by the side wall of the casting mould, which inward displacement is conical in shape.

20. A method of manufacturing a composite contact lens as claimed in Claim 4, wherein the inward displacement in the end wall of the mould may comprise an upstanding cylinder.

21. A method of manufacturing a composite contact lens as claimed in Claim 4, wherein the end wall of the casting mould is formed from polymethyl methacrylate, and the penetrating like material of the first and second monomer material is methyl methacrylate.

22. A method of manufacturing a composite contact lens as claimed in Claim 4, wherein the end wall of the casting mould is formed from polymethyl methacrylate, and the penetrating-like material of the first and second monomer material is a methacrylate material.

23. A method of manufacturing a composite contact lens as claimed in Claim 4, wherein the end wall of the casting mould is formed from cellulose acetate butyrate, and the penetrating-like material of the first and second monomer material is a liquid vinyl monomer material.

24. A method of manufacturing a composite contact lens as claimed in Claim 4, wherein the end wall of the casting mould is coloured.

25. A method of manufacturing a composite contact lens as claimed in Claim 4, wherein the end wall of the casting mould has a thickness in the region of 0.1 mm to 2 mm.

1/2

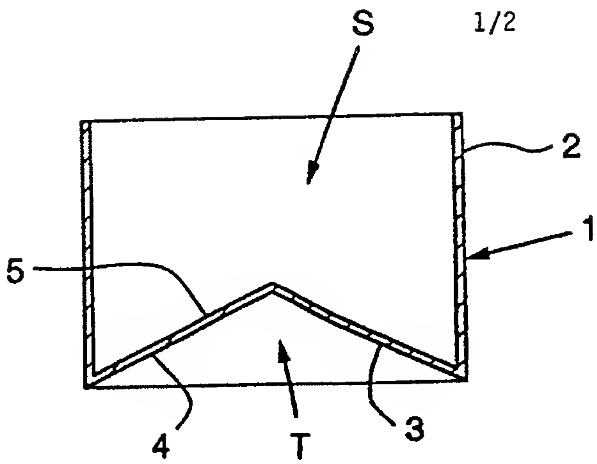

FIG. 1

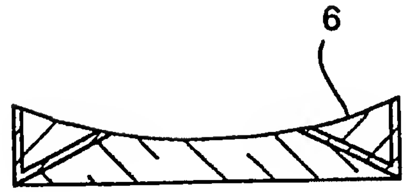

FIG. 4

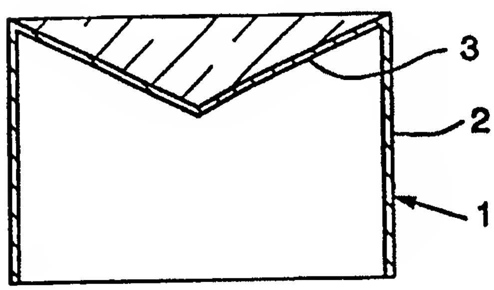

FIG. 2

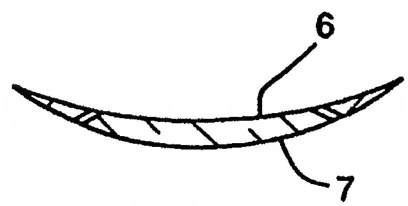

FIG. 5

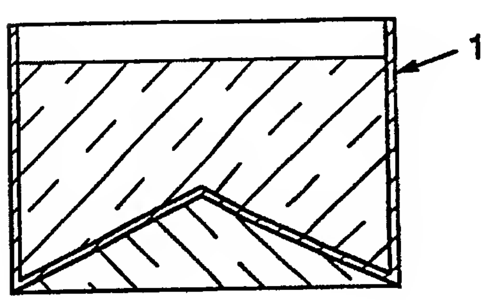

FIG. 3

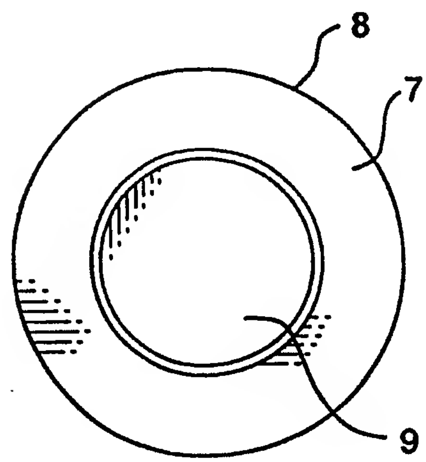

FIG. 6

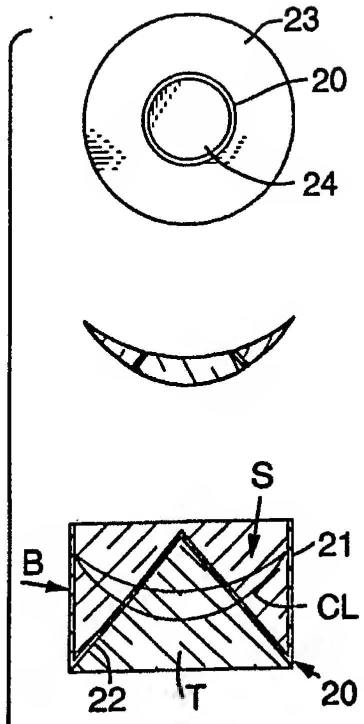

FIG. 7

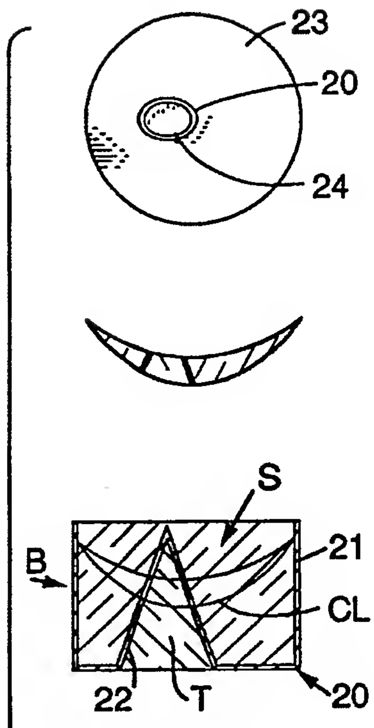

FIG. 8

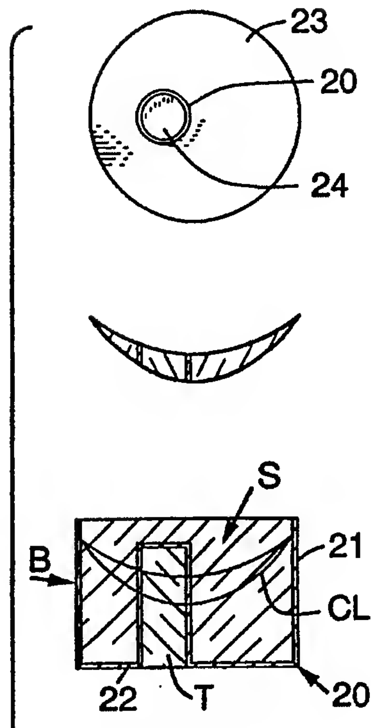

FIG. 9

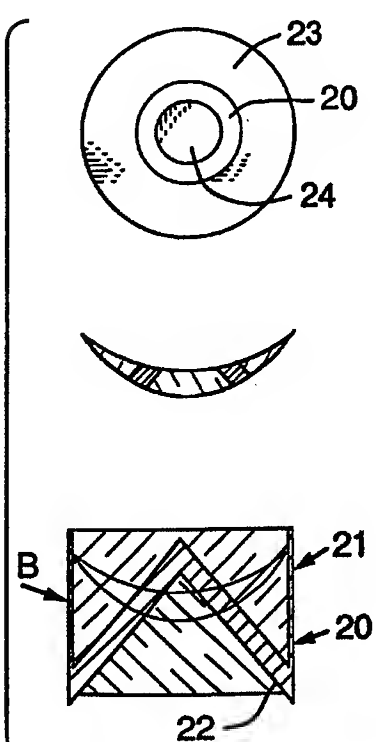

FIG. 10

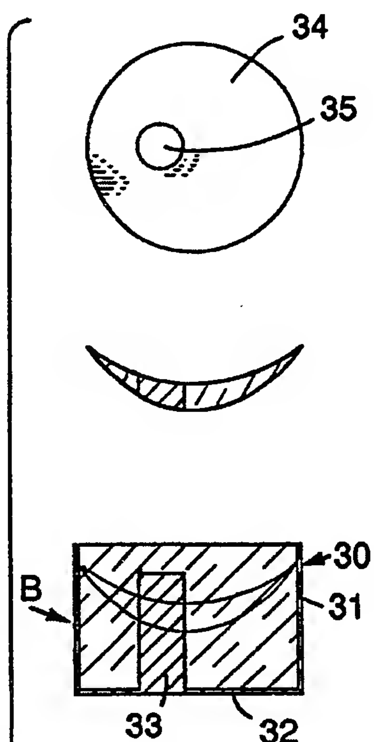

FIG. 11

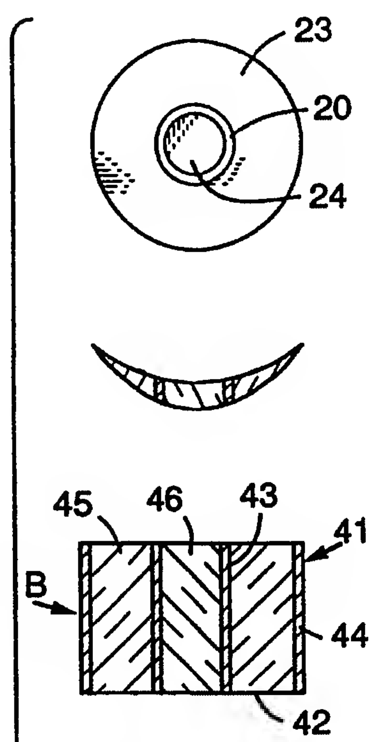

FIG. 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/08455

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :B29D 11/00
US CL :264/1.7, 1.8, 2.1, 2.3, 2.7
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 264/1.7, 1.8, 2.1, 2.3, 2.7

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 3,697,629 (Bronstein) 10 October 1972, col. 5, line 34 to col. 6, line 4; col.6, lines 33-44, figures 5, 11, 12	1-3, 10, 15-17
X	US, A, 4,921,205 (Drew, Jr., et al.) 01 May 1990, col. 4, lines 21-48; col. 5, line 48 to col. 6, line 31.	1, 3, 7, 8, 10-17
A	US, A, 4,208,362 (Deichert et al.) 17 June 1980.	1-25
A	US, A, 3,984,506 (Tsuetaki) 05 October 1976	1-25
A	US, A, 4,197,266 (Clark et al.) 08 April 1980.	1-25
A	US, A, 4,710,327 (Neefe) 01 December 1987.	1-25

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 06 October 1993	Date of mailing of the international search report 21 OCT 1993
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Authorized officer JAMES LOWE
Facsimile No. NOT APPLICABLE	Telephone No. (703) 308-3834

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/08455

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4,710,328 (Neefe) 01 December 1987.	1-25
A	US, A, 4,460,523 (Neefe) 17 June 1984.	1-25